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AUTHOR Quinsaat, Marilyn G.
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ABSTRACT

Using a case study approach, this report summarizes a teacher's observations of students working on a personal computer in both classroom and nonclassroom settings. The first section addresses teacher concerns about technology in education, such as fear of replacement by a computer and other symptoms of computer anxiety. Four phases of classroom computer implementation are then described, and a computer club for fourth-graders is discussed. Introduction of a computer into a fourth-grade classroom and the overall effect on classroom functioning is then described, including considerations of classroom organization, scheduling, management difficulties, time-sharing, and grouping. The results of videotaped observation of students, which was used to study the effect of various grouping arrangements on student interaction, are analyzed. Finally, issues of concern in using computers in a primary classroom are addressed, including motivation, difficulties in reading and equipment use, and use of fifth-grade tutors. This section also summarizes procedures, results, student reactions, problems, and possible solutions. Two references are provided. (LMM)

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Implementing Computer Technology in a Classroom Setting: An Anecdotal Report of Long Term Use

Marilyn G. Quinsaat

Oceanside Unified School District

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This paper is intended as a report of observations by a teacher of students working on a personal computer. The report will address issues such as concerns teachers may have about computer technology in education, the actual implementation of a computer in the classroom, the effect on the overall functioning of the classroom, the effect on interaction between the students, and differences between age levels.

While computers are working their way into more classrooms, or at leeast effecting more people involved in classrooms (through exposure in offices, stores, arcades and home games), it seems more and more apparent that while children are giving rave reviews, teachers are remaining more cautious. Teachers have a number of concerns about how this new technology may effect their profession. For example, computers are generally seen as non-humanistic. Visions of a room full of children, each hooked up to a computer instead of interacting with other childrn quickly come to mind. Computer games are also pictured as being simply drill and practice activities. From a more technical perspective computers are seen as being too difficult for an average person to operate. What if the computer should start making drastic errors?

From a more personal standpoint, many questions might pop into a teacher's mind. What if a computer "outsmarts" me? What if a computer-crazed student outsmarts me? What if a computer replaces "thinking"? What if a computer replaces me?

These concerns are grouped into what many people are calling symptoms of "computer anxiety", in which cases have only been reported among adults. The reason for this may stem from the fact that children are growing up in a computer age, while adults must learn to accomodate. Children are also being oriented to computers in much more pleasing ways. e.g. arcades and home games.

These issues are brought up to give a backdrop of observations of my students and why I was looking for and perhaps found, or didn't find the things that I did. These observations were intended to answer many questions that were in my mind and questions which might concern teachers in general.

Phase 1-The Computer Clubs

Levin and Kareev (1980) report a grassroots phenomena concerning computers in the classroom, in that many teachers are bringing their own personal computers from home. Since school districts tend to be conservative with curriculum and finances, most teachers who would want to risk trying a computer in their room are most likely those who have had substantial experience with computers and probably own or have access to one. In this respect my experience is slightly different from most teachers today. I was first exposed to personal computers through an NIE research project that was being conducted in my classroom.

The 3-year project was designed to study the constraints children encountered learning the same task across school and non-school settings (Cole, Griffin and Newman, 1979. Video tapes were to made of large group lessons, small group lessons, lessons without a teacher, one-to-one tutorials and after-school clubs. One of the after-school clubs was a Computer Club organized and led by Jim Levin and Yaakov Kareev, members of the Laboratory of Comparative Human Cognition.

The clubs were intended as settings in which features of formal education (books, tests, teachers) were non-existent. However, when the idea for the computer club came up I was indeed hesitant. I was not sure that this was the kind of activity that I wanted my students to engage in. Levin and Kareev spent some time teaching me the games and asking my advice on making the programs workable for 10-year-olds. After watching the initial video-tapes, I was both surprised and pleased at the findings. I found that students had virtually no anxiety about computers. In fact, I have yet to find a student who has refused to try the computer. The excitement was obvious and continued through the 4 sessions of the clubs over a period of several months. However, I noticed that some students tired of the games near the end of the 2 hour club sessions. Perhaps that was too long for a student to participate. I began to think about how a computer could be implemented in a room such that learning could be done and every-day management of the classroom could still go on.

Phase 2- Computers in a 4th grade Classroom

The researchers agreed to let me borrow the computer for a week to see how it would work. It is important to note that my intentions for having the computer was to examine the feasability of students operating one. I was not at all interested in field-testing educational software, and because of that I decided to start with commercial games. Levin and Kareev seemed to meet with success in their computer clubs by introducing games to the children. Games seemed to be a pleasant and therefore, motivating way for children to learn how to operate the computer.

My room is normally organized in such a way that students rotate to various activities throughout the day. The students are ability grouped in various subject areas and are often following schedules which require them to be in different parts of the room during different times of the day. It would not have been unusual to set up a computer schedule also. The computer was seen as merely one more activity to rotate into.

Not all of my students were members of the computer club, but certainly enough were there to rely on as extra sources of expertise. The computer was introduced in a whole-group lesson. Mechanical instructions were demonstrated, while important commands were written on the board. Also on the board was a schedule for computer usage. Students were responsible for maintaining that schedule. Remembering to go at the allotted time, quitting when the time was up, and rescheduling during conflicts

became their responsibility.

As far as the over-all management, the students were very conscientious about handling the schedule without my having to worry about it. On the few occasions where students did forget, there was always some other anxious person who would remind her.

However, two problems did arise one of which was easily rectified; the other becoming part of the classroom computer culture. The former concerned a rule I had established stating that a person previously assigned to the computer was allowed to finish the game she was on if her time had run out during the change in schedule. Some quickly realized that if they started up a new game just before their time ran out they could buy themselves a few extra minutes of the next person's time. The rule was then changed to "Your game ends when your time ends." (This solution would probably not work well if the students were working with an editor at the time. A lot of writing might be stifled if someone were told when to quit.)

Another problem centered around the sharing of computer time. In most instances, I gave the children the option of choosing a partner to work with. After a few days, new "friendships" seemed to blossom, particularly if you were a student who was assigned to the computer sometime that day. All of a ichildren would volunteer to help you with schoolwork or play with you during recess. There were a few times when conflicts would arise because of these new found friends. Still, it was interesting to

watch the children creatively alter their social patterns.

In order to see which combinations of people were the most productive, I organized the first three days such that the children were grouped in a variety of ways. Some groups consisted of a computer club member with a non-computer club student, a strong reader with a weak reader, a student alone, and a student alone with the option of choosing a friend.

By and large the grouping that produced the most interaction and the most cooperation in problem-solving was when a student was able to choose a partner. In the other groupings, computer club members tended to monopolize the game time, although they were passing on vital information due to their expertise. A non-reader and strong reader turned out to be an uncomfortable association. If the two were not particularly good friends the good reader would not necessarily help out the weaker reader. And a student assigned alone tended to look bored.

However, in a "your-choice" pairing the interaction was quite differet. In all but one case, students always chose to have a partner. (In that exceptional case, the girl finally chose someone after 10 minutes of playing alone.) Students always chose partners in spite of the fact that they would often choose games not requiring any interaction. The students seemed to create their own reasons for interaction such as competition, (who could get a better score when one person plays a game and the other plays the same game immediately after), encouragement

(cheering them on during a particularly thrilling game), and assistance (particularly for figuring out strategies and lower-level skills such as remembering to press RETURN after typing in commands).

By the end of the week, it became overwhelmingly apparent that the students were thoroughly enjoying themselves. But was anything good coming out of it besides? A closer look revealed the students dealing with many valuable tasks. While my sharper students were given an opportunity to be challenged, the low-achievers were given an opportunity to show their expertise in ways that couldn't before. These students were extremely motivated to find strategies for playing better.

For example, Erick was a particularly quiet student who had difficulty demonstrating school activities that he could master well. Either his shyness prevented him from revealing strengths, or he had very few school type strengths to show. Yet, he turned out to be the classroom's highest money-maker in a game called "LEMONADE" in which players earn money operating a Lemonade stand but must work with factors which effect operating costs. It turned out that Erick's parents earned a small business and he had picked up some strategies from them.

Another example involved a student whose practice on the computer actually effected her schoolwork. Margaret was a student who had a particularly painful time writing reports. Yet she seemed to enjoy a game entitled SCIENCE FICTION STORY WRITER

in which the computer assisted a student in creating a story by offering parts of the plot. After Margaret's computer time was up in which she had created several "stories", she then sat down and wrote a 3-page report that was assigned as a California History Project. In this case the computer had worked in a way that other "motivators" could not.

During this second phase, researchers were on hand the first few days to lend assistance and to take observational notes. They were also available to modify programs if that were needed. (This was an important advantage which may not be readily available to teachers.) But on the whole, the computer caused very little disturbance on the over-all functioning of the classroom. I explained to them, that I had to go about my teaching and therefore was not always free to deal with their problems. They were to do their best trying to solve the problem and should only come to me if it were absolutely necessary. Generally, the students managed to solve the problems on their own except when a problem occurred involving some programming knowledge.

Phase 3- Videotaping Students on Computers

At this point it occurred to me that the interaction itself was worth a closer look. I asked the researchers if I could borrow the computer for another couple of weeks, but this time to videotape some of the sessions. Since they already had tapes of students with computers in an after school setting, tapes of students during school could be important data.

During this third phase, the groupings were made by the "You may choose a partner, if you prefer" method. Computer time was about 20 minutes per group, which was long enough to play a few games, but short enough so that as many groupings as possible could occur in a day. A student was usually assigned on the computer sometime within a two-day period.

There are 15 groups presently on videotape, of which some preliminary observations could be made. Students tended at first to pick partners of the same gender and this was usually a good friend. By the fourth day, I believe as more and more students became competent with the specific programs one boy, Michael, chose Angelica for a partner. While Michael has an ample amount of male friends to choose from, it is also well known around the classroom that Angelica is extremely competent in mathematical skills and could be very valuable as a partner in certain games. Michael had now established a new precedence for choosing partners based on skill. I do not doubt that this also set the way for students to choose opposite sex partners for other personal reasons since there were some pairings which I could not explain by the participants' skill.

Towards the end of the two-week period students were commenting that they were becoming more and more familiar with operating the machine. They were remembering more commands, were more familiar with the keys so that searching was no longer a time comsuming part of their operating time.

By this time I was convinced that the impact of computers in the classroom was, whether external or not, a phenomenon I could not ignore. Feelings of anxiety began to diminish as I continued to watch the excitement of my students, their motivation to do problem solving and the amount of interaction going on.

Phase 4- Computers in a Primary Classroom

My own fears about being replaced by a computer were forgotten as I became more interested in thinking of ideas or modifications for programs, or how I could implement certain programs in my lesson plans.

This became the impetus for the next phase of studying computers in my classroom. However, during the next school year my classroom would undergo a great chage which would affect my ideas on implementing a computer. Due to enrollment f;uctuations, I went from teaching 4th grade students to teaching a combination Kindergarten-First Grade.

The change quickly ignited a new set of questions. In what ways would it be feasible or not feasible to place a computer in such a classroom? Would it still be highly motivating? Would the mechanics be too difficult? Would playing the games be too difficult? Would not being able to read the text pose a large problem or discourage them? Would working the keyboard be too difficult? Or would playing with the computer motivate them enough to learn their letters, numbers, or words in order to

acquire computer literacy?

The change in grade level required that the organization for using the computer be different, since the children can't tell time, can't read to figure out a schedule and are less likely to be able to work independently. While I do not consider my methods for dealing with these problems the best way to implement computers, most teachers would probably try such a venture as conservatively as I did.

I was primarily interested in observing what kinds of problems primary students would have dealing with what I would consider as the 3 levels of operating a computer. The first level involves the mechanical aspects of setting up the computer. This included loading the disc, turning the machine on, adjusting the monitor, knowing when the disc was being loaded and reversing the operation when their time was up. The second level involved game selections. A player needed to choose a game, get the game started and ended. The third level was the ability to actually play the game.

Students from the University were on hand the first week to take notes and offer assistace to the children. Also acting as tutors were two 5th grade students from the previous years class who came in during recesses and lunch periods to give cross-age tutoring in exchange for their own private computer time. It was interesting to note that their method of assistance tended to be much less verbal and much more straight forward than the adults.

The tutors would give a synopsis of lengthy instructions that appeared on the screen as opposed to reading them word for word. One disadvantage was that in their zeal to operate the computer the tutors would often "do" more for the students. One first grader complained that he could never type anything for himself.

But overall, the older tutors were extremely competent aides. When a problem occured, I was amazed to see how quickly they were able to size up the situation. The knowledge they needed in order to assist was really quite minimal. In fact, a parent volunteer could probably learn enough to serve as an aide in a primary classroom in a matter of minutes.

With the issue of extra help taken care of, I then needed to worry about how the computer was to be set up. The computer was placed on a large table close to the teacher's desk. Originally, the computer was visible from all parts of the room, but that tended to be too distracting. A cardboard partition was placed on the table, so that the rest of the class could go about it's business.

On the first day, I gave a short lesson to the whole class about the computer and how to operate it. The children were quickly fascinated by it. An explanation was given about the different features of the computer and basic operating instructions; how to put the disc in, turn the machine on, turn the monitor on, and choose from the MENU (a list of the games from which the students merely had to press the letter that corresponded to the

game.)

I demonstrated two games which they could play on the first day. One game was called BRICKOUT, which resembles many of the television-video pong games commonly on the market. The other was AIRPLANES, a game in which the player fires a gun to shoot down airplanes flying across the screen. Both games were designed for one player at a time and both require more use of an attached "paddle" which serves as controls for various games.

While many of the children were familiar with the pong-type game, none had ever played the AIRPLANES game which was quickly seen as the most exciting of the two. The children were particularly excited about the graphics of airplanes being shot down, which resembled fireworks exploding.

The two rules used in the 4th grade classroom were used along with a few others. 1. Try to play on the computer as best as you can without having to disturb me unless you absolutely have to. 2. Your computer time is when a teacher assigns you to a time. 3. Your computer time is finished when a teacher tells you the time is up whether you're finished with a game or not. A few other rules were established to reduce over- anxiousness in the classroom climate. Students are not to hang around the computer to watch when they are not assigned. Any loitering will automatically disqualify them from a turn on the computer that day. And students are not to ask the teacher when they're computer time is.

During the first week, children were assigned so that everyone would have have a chance to play on the computer. Again they were given the option to choose a partner, and again no one has yet turned down that option in spite of the fact that they often chose programs that were not designed for two people.

During the second week, children were chosen by me depending on the classroom situation at the time. In some cases I would choose children who had finished their work or who were working quietly and independently. Or, if I were teaching a lesson at the time I would choose students who had demonstrated that they were more capable than others of working on the computer with relatively few problems. Or, if another adult or tutor was available I would assign students who could use the extra assistance.

By the third week, the children seemed to be extremely efficient at playing with the computer. More games were being introduced and students were having very few problems playing the games. The repertoire of games included SIMON, a memory game of lights, numbers and sounds, PENNY ARCADE, a variety of competitive games which required two players, ROADRACE, a car race game which required one person to navigate the car, and another to control the speed, and NEW INVADERS, a penny arcade game with attacking aliens for a theme.

I decided to review the operating instructions one more time with the kids and tell them that if they wanted to play on the computer, they were going to have to learn how to control it themselves. Operating the computer became their responsibility if they wanted to use it in the same way that they use other games and equipment in the classroom. University students were now coming down once a week primarily to take observational notes.

The students were not frightened of this responsibility at all. Many students had displayed a frustration earlier because they were not allowed to work the computer enough. For example, typing on the keyboard held a particular fascination for them because they were learning the alphabet or just learning how to spell.

Students seemed to be very efficient with respect to the mechanics of the computer. Instead, difficulties stemmed from not being to able to get through the preliminary startings of several games, because they couldn't read text on the screen, and having to memorize the different operating instructions for each particular game was too large a task. For example, after telling the students that they would have to start operating the computer by themselves as much as possible I began to review with them the varicus parts of operating it. At one point I explained how they could start a new game by calling up the MENU. One student raised his hand and asked, "But what if we can't spell RUN MENU."

I was surprised to find that they were more concerned with language barriers than with the mechanics.

Some students were having a difficult time knowing at what level the computer was working. They couldn't tell the difference between the computer loading up, when it was searching for a game, when the game was actually set up, or when they were in the middle of instructions. For older children, these problems are normally solved by reading the text. Some students have solved that problem by "memorizing" operating instructions for certain games. The difficulty is in keeping instructions for the various games seperate. While making an honest effort at memorizing instructions some students would use commands for one game on another.

Some of these problems were alleviated in various ways. One way was by having a friend play with you. Often times that friend would help remember instructions or would alleviate some of the burden of remembering how to run a game. For example, if a student were typing RUN MENU on the keyboard, the other would be checking the screen for typing mistakes. Or, if a student was trying to figure out a specific command the other might remind her to press RETURN after giving the instructions.

At one point I had noticed that some instructions were easier to memorize for the kids than others. These instrustions seemed to be similar in the way in which the text was constructed, For example, wordy text was extremely difficult to

memorize. But less wordy text was much easier, and easier still if the text was "shaped", such as in a short list, or with numbers, or in "block" form. If there was a recognizable figure or character the students tended to remember that and seemed to associate it with a specific set of instructions.

But on the whole, the students were plagued with the problem of not knowing how to read and therefore not knowing how to follow directions. The games chosen were common commercial games not specifically written with a Kindergartener in mind. The apparent inability of children to play these games should not lead one to believe that Kindergarten children cannot successfully operate a computer. Many aspects of setting up the game are not necessary for primary children and instead add rather cumbersome steps. For example, in order to play NEW INVADERS a player must first call up the MENU, identify the game, and press the corresponding key to call up that game. As the computer is loading up the game, the player must be able to recognize when the loading is occuring and when it if finished. (The screen displays a few words stating that the game is being loaded.) The program then displays on the screen a list of 6 increasing levels of speed related to the operation of the game with the higher levels being the most difficult. The last level is "LIGHTNING SPEED. IMPOSSIBLE!" Students must then choose a level by pressing a corresponding number key.

A next line of instruction immediately appears on the screen which states "AUTO FIRE (Y/N) ?" The line is so small compared to the rest of the text that the students often don't see it and wait several minutes for the computer to do something. There is no adjoining text to explain how AUTO FIRE effects the game.

After students make this selection a new set of instructions appear on the screen.

1. DEMO
2. PLAY
3. EXIT

Pressing 1 will give them a demonstration of the game. Pressing 2 will allow them to play. Pressing 3 allows them to leave the game and start all over choosing levels of speed. This set of instructions appears at the end of each NEW INVADERS GAME. Once explained, students have very little trouble remembering it. When it appears on the screen students immediately know what to do. The words are simple to read, it comes in the form of a numbered list, and is displayed in block form as opposed to paragraph form.

Another game, PENNY ARCADE, uses paragraph form to display instructions. It displays two pages of extremely wordy text with the first page ending with instructions to press the SPACE BAR in order to continue and the second ending with instructions to press the RETURN KEY. Students seem to have difficulty remembering which comes first. At another point in the instructions, the players are play with gravity. Two Kindergartener girls were at

this question when one of them pressed the key requesting gravity. The other student asked why she wanted gravity. She answered that she didn't know, but that she just wanted it. It was unclear to the observer whether these students knew anything at all about how gravity would effect the game.

It would seem then that many aspects of these instructions are unnecessary in order for the children to operate the computer and play the game well. 5 year olds don't need 6 different levels of speed to choose from and the question about gravity could have just as well been left out. Aside from the language problems, children seem to be meeting with a lot of success in operating the computer. Games could be easily designed in which the text could be written quite simply with a minimum of choices in playing the game. More levels and ways of making the game interesting and difficult can be added as the students become more proficient in reading and playing the games. Some games could be designed such that a demonstration is first displayed giving the students a context for understanding the instructions.

While the students seemed to be quite comfortable in operating the games, it should be understood that they did not immediately play the games with a high degree of expertise. In some cases a few students totally misunderstood the intentions of the game. For example, in BRICK OUT the object of the game is to control a bar which serves much like a ping-pong paddle, such that an oncoming ball ricochets off the paddle and knocks out the

bricks of a wall which is displayed on the opposite end of the screen.

Two kindergarteners who were playing the game for some reason thought that letting the ball hit the paddle was an undesirable aspect of the game and proceeded to play "dodge ball" instead. In another case, another student was having an extreme amount of difficulty guessing where the ball might hit and manuevering her paddle such that they would meet.

These types of problems were sometimes dealt with assistance from a partner. Oftentimes a player would run across a partner who knew the intention of that particular game and would clarify the issue, or who had come up with some strategy for playing the game better. This was particularly true in the 4th grade class where news about how to play a game more efficiently spread quickly among the students.

In the case of the primary students, some partners gave assistance as to how to move a paddle effectively in order to aim a gun, or track a ball. In one particular case, one students hands were so small that she couldn't effectively operate a paddle. Her partner assisted by turning the dial on the paddle to aim the gun, while she pressed the button to shoot.

Early on when I noticed that students were having difficulty coordinating the use of the paddle I taught a pair how to hold the paddle in their right hand using the thumb to press the but-

ton (often used for shooting) on the side, while the the left hand manuevered the dial (which was often used for aiming or controlling speed). I never had to explain this strategy to anyone again and after a week noticed that most of the students were using this method.

As the weeks progressed the students became increaasingly proficient at playing the games especially with assistance and encouragement from partners, but I also noticed that they were choosing partners for reasons which had little to do with coordinating the operation of the machine. As with the 4th graders, being in a position of choosing a partner was extremely prestigious for kindergarteners. Suddenly, they had a lot of friends, and if they stalled long enough, were in an enviable state where the other children were begging to share that computer time.

Once the person was chosen however, the pairings did not always result in a lot of problem-solving. In a few cases the chooser would select a game and leave the chosen to simply sit and watch. A couple of times the chooser would play for awhile and then hand over the computer time to her partner, while she went back to whatever she was doing before.

However, most of the time a lot of interaction was going on, some of it involving how the time was going to be used and how that time was going to be divided. It was not established at the outset how the children were to share the computer time, which left them to negotiate among themselves. This division usually

depended on the games chosen. The students might divide up turns. ("You shoot one and then I'll shoot one.) Or they might divide time according to a complete game. ("You play one game and I'll play the next and we'll see who gets the highest score.") Some partners pro-rated the time. ("You played one long game, so I get to play two short ones.) In general, I was surprised to find that most of the share time was worked out quite equitably.

There were, of course, the divisions which were worked out more according to personality then to fairness. These included partnerships where one person was much more persuasive in decision-making. In spite of that, there seemed to be little complaining to the teacher about turn-taking. It's not clear whether this is due to the fear that complaints may result in the loss of that computer time. My own observations lead me to believe that the students simply share a particular goal and that compromises get made while problems get sorted out. In this case, the goal they share is to figure out how to play on the computer. The students seem to be finding out that helping each other out is a good way to get the job done as well as keeping problems to a minimum.

The primary students have just completed their 7th week with the computer. They are still having trouble with the text for instructions although I suspect that will get easier as we modify games to simple levels of operation.

In this particular class, we are ready to try different phases of teaching children how to operate the computer. I am interested in introducing games which would allow the students to use the keyboard more. I suspect that the kids will welcome this since they seem to have a facination in searching for the letters. This is also a task where they can help each other find the keys. With this in mind, it might be time to consider more academic games which incorporate words that the first-graders are learning.

In general, it seems that with the right modifications it is quite possible for young children to begin instruction in computer literacy. Adjustments need to be made with respect to appropriatness of games, revising text, making instructions simpler. The notion of children working on computers alone and not interacting with people should be disbanded since they seem to like to work together. People writing software might note this advantage in interaction by making it possible for more than one person to play a game. Programs could be written where the students need to share the responsibility of solving the problem.

This experience may shed some light in answering the concerns which many teachers have about computer technology. A computer can, in fact, be placed in a classroom without causing too much disruption and still have benefits. The children were able to interact with each other, while learning interesting things. The computer was not too difficult for the students or the

teacher to operate. And at this point, the notion of being replaced by computer seems far-fetched, considering the other responsibilities that teachers must deal with. And as I find myself becoming more proficient with operating a computer I am constantly evaluating ways in which I can make the experience productive for the students. The experience of having a computer in the classroom brings to light the ways in which the computer can be used as a tool for learning. But it also emphasizes the issue of the computer as the object of instruction, and reminds us of our responsibilities as educators in an increasingly technological society.

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